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SHELL STRUCTURES

by Heikki Seppa

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RESEARCH PAPER ON SHELL STRUCTURES

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In an effort to restore creativity and spontaneity to the realm of metalsmiths' forms, research is currently being conducted at Washington University School of Fine Arts, St. Louis, Missouri. This research began in 1973, and has involved faculty and students alike. The result has been the rediscovery of the hollow shell form, an attendant generic vocabulary, and the redesigning of necessary tools.

Historic Background Against Which New Developments Can Be Measured

Shell structuring may be viewed by many as a new technique; however, examples can be found in museums throughout the world of this kind of work done by metalsmiths which date back to ancient times. These craftsmen provided vessels for functional use and festive occasions, and spontaneous creativity flourished. Today the work of these artists is viewed by historians and archeologists as the embodiment of their particular culture.

With the introduction of the machine to the world of metalsmithing, inventiveness was lost and thus new forms did not evolve. Because of the limitations of the machine, only six rotation surfaces and their 'variations' were possible and these were locked into the craft. In addition, handcrafted appendages, which had tested the skill of the craftsman even more than the central body, began to be made by machines. Large presses turned out designs which were left-overs from the silversmith's past. His creativity went unchallenged and eventually atrophied.

With the discovery of new materials such as plastics and metal foil, came the deathknoll for functional silver objects as they had been used throughout history. Containers and utensils made from these materials were so inexpensive that they could be discarded without a second thought. Consumers' mentality began to disallow functional finery in the home and silver objects became less popular. They were used only for decorative purposes, if at all.

Machines and consumer mentality created a situation in which there was no place for the silversmith. As a result, the number of these skilled craftsmen dwindled until, in the late '30's for instance, there were less than half a dozen in the United States who knew how to raise a vessel from a flat sheet.

It is a sad commentary to note that industry, which had robbed the very heart out of the silversmith by introducing the machine with its limitations, did not find a way to correct the errors, even for its own benefit. Even today industry is digging its own grave by not promoting the use of silver, by not hiring educated talent, by neglecting research and by still hanging on to functionalism which is no longer in keeping with the times.

Metalsmithing In Universities And Art Schools

It was the consciousness of the educators who began the rescue of the lost skills. This was done, not so much for the benefit of the industry, but for the social good.

After World War II, art schools and universities in the United States began to establish craft departments but had great difficulty in finding qualified instructors for the metal smithing classes. As a consequence, they were compelled to educate the educators. However, progress was slow because the technical knowledge spread only as fast as the skills were learned. The available silversmithing instructors in America were either art oriented without much technical knowledge or technically trained without an art background.

Many art schools solved the problem by importing art-craft teachers from abroad. These teachers had good backgrounds and were able to import valuable technical knowledge into the craft movement. The most important contribution was the revitalization of holloware.

Unfortunately, however, the work methods were hangovers from the underdeveloped form cult of the machine age. There were basically only three forms: the domical, the cylindrical, and the cubical. Within the confines of these simple starting points however many splendid mutations were derived by hundreds of metalsmithing students in dozens of art schools. But it is sad to note that very little holloware activity continued beyond the school years. We can guess the reasons: the customs and habits of patrons had changed; the demand for the ecclesiastical silver had diminished; and, most importantly, there was an absence of exciting, new, designs. Fortunately, in their wisdom and enthusiasm, the art schools taught the raising skills to so many students that at least there is now a strong base on which to start another era of sheet metal work.

Beginnings Of A New Era

In beginning our research at Washington University, we identified the problem and began to solve it by first dividing the metalsmith's work experience into parts. We isolated two major areas of concern for all craft designers in hard media. First, there was the surface enrichment activity which was pre-occupying many smiths totally. They were embellishing old, worn-out basic forms in an attempt to bring newness into their work.

Next they focused on these outdated forms which had been neglected for a long time. The same forms had been used for many years and required the same raising and minimal seaming techniques for their manufacture. On the other hand, these old forms had a great deal of appeal because the volumetric stability lent itself so well to functional application. It was almost impossible to break the cycle.

Futher analysis revealed that the existing literature on gold and silversmithing ignored the development of three-dimensional forms. The basic c design chapters were borrowed from the visual arts, suitable for painters but not for craft designers. Their focus was on the surface design and not the form.

Because of the lack of course content for the study of forms, there was no incentive to go beyond assigned requirements. It was no joy to spend hours of work merely to produce another bowl, or a mutation of a cylinder, let alone mitering corners for the same cubical boxes — same demonstrations, same examples year after year and, worst of all, the same results.

We decided to focus on form rather than surface, but this represented a sacrifice. We had to forgo many exciting surface techniques in order to gain time.

We also decided not to concentrate on the usual volumetric forms and no longer work on the utilitarian objects. Therefore our design options were at a minimum. The only thing left was the medium and we let it dictate to us. Its ductility and malleability lead us toward more organic expressions.

FIGURE 1 - NODUS
NODOID. . .AL

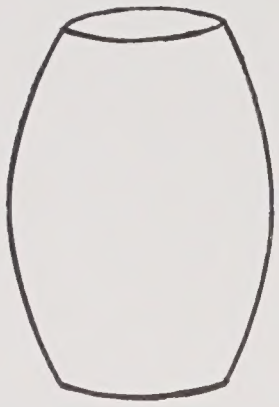


FIGURE 2 - CATENOID. . .AL

FIGURE 3 - UNDULOID. . .AL
UNDULATE. . .D

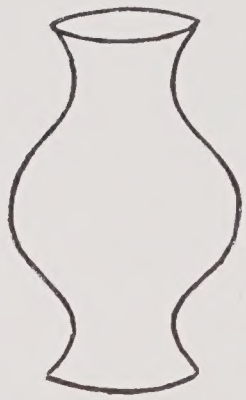


FIGURE 4 - INFUNDIBULUM

Vernacular

To work on the form we needed much more communication than we had available. There was the seldom-used nomenclature of geometric forms, but the language hardly went beyond that. We were horrified to learn that even the old forms which we had used for years did not have professional names. It was embarassing to face this kind of short coming and at the same time speak ponderously about professional traditions with integrity. The sheet metal forms had been "invented" by silversmiths and yet we did not know what to call them.

We could describe the forms, but it had to be in terms of already existing things — by the "it looks like" syndrome. We felt that having to relate so closely to something that was already in existence was not encouraging the creation of something new.

New words had to be put to use. Once we found new forms, we had to find names for them. Following the example of architects who used generic names for forms, we adopted the same practice. As we progressed, forms suggested names and names suggested forms, and our list grew up to 80 form names.

The generic names rendered a host of derivations permitting more fluent nuances of form descriptions. We listed twelve suffixes which could be attached to a name to modify it to suit different meanings. And some of the names we listed were not really generic at all but simply Latin or Greek names for implements. Their remoteness, however, made them more acceptable.

Generic names were given to a host of old forms: see Figures 1-6. Contemporary silver students never had names for such standards like: see Figures 7-9, —

let alone the most documented lenti-forms with their respective descriptions: see Figure 10.

FIGURE 5 - SPHENE
SPHENOID. . .AL
SPHENIC

FIGURE 6 - SINUSOIDAL
TAPERED TUBE,
TUBATE

FIGURE 7 - TORUS
TOROIDAL

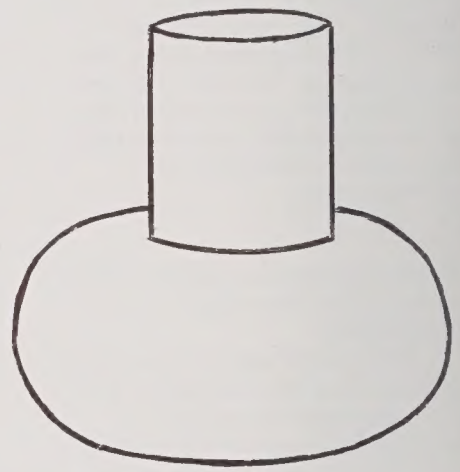
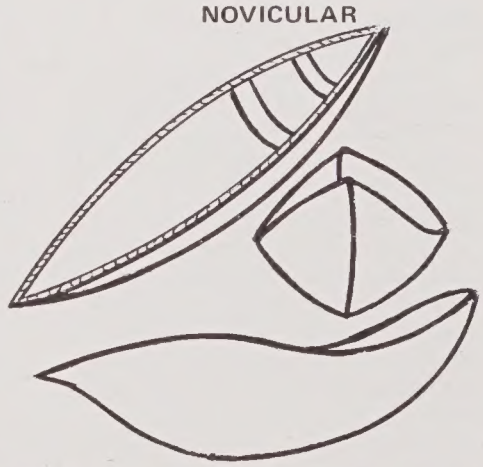


FIGURE 8 - CAMPANULATE
CAMPANULAR

FIGURE 9 - CYMBI FORM
SCAPHOID
NOVICULAR



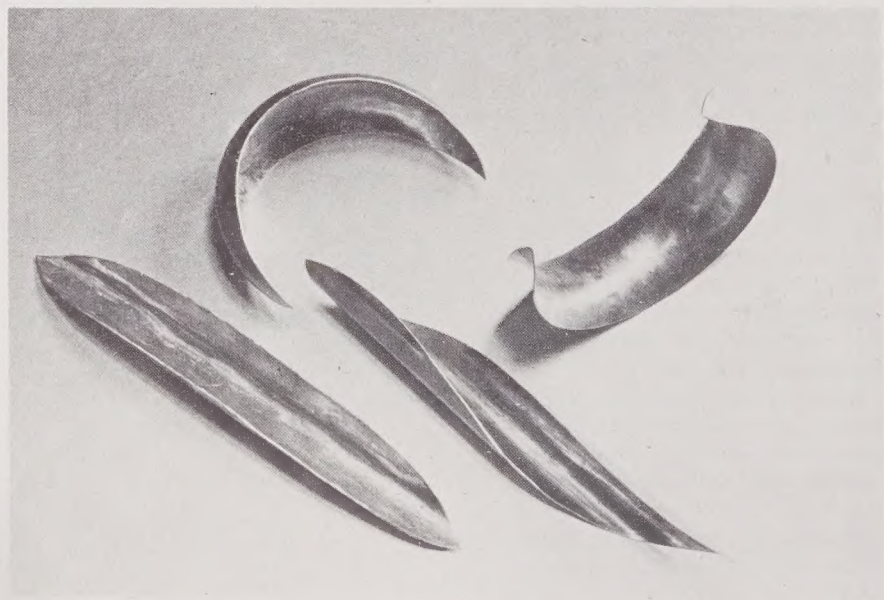
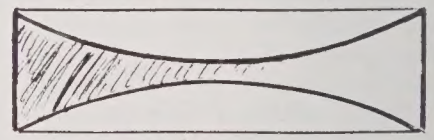


PHOTO 9 - OF FOUR BASIC FORMS
ANTICLAST SYNCLAST,
TWIST, FURROW

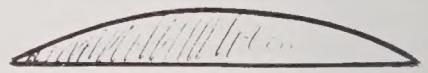
FIGURE 10 - LENS, LENTOID,
LENTI FORM

BI-CONVEX

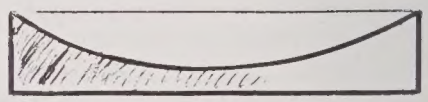
BI-CONCAVE



PLANO-CONVEX



PLANO-CONCAVE



CONCAVO-CONVEX

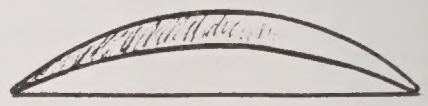
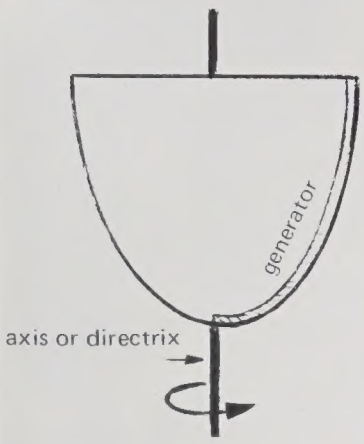
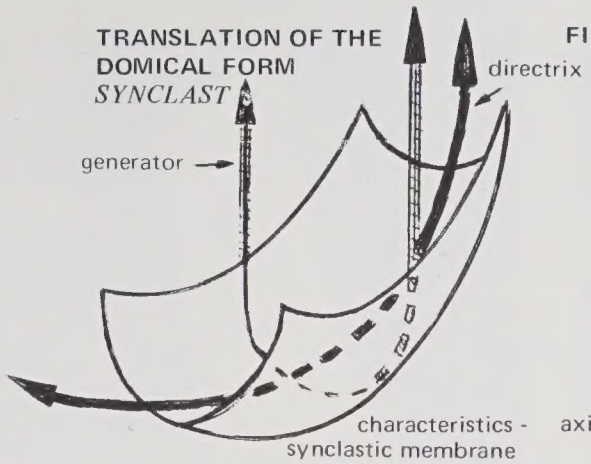


FIGURE 11 - DOMICAL FORM

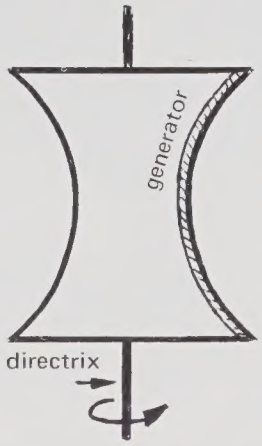


TRANSLATION OF THE DOMICAL FORM
SYNCLAST

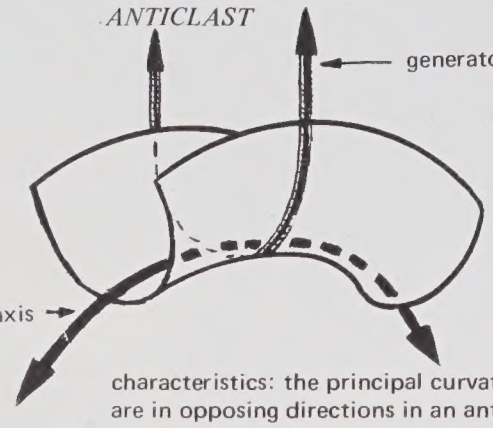


having both principal curvatures in the same direction.

FIGURE 12 - CATENOIDAL FORM



TRANSLATION OF THE CATENOIDAL FORM
ANTICLAST

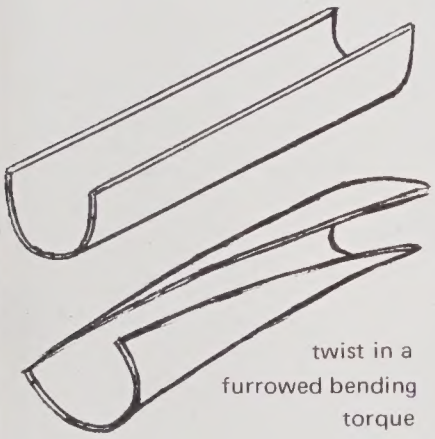


characteristics: the principal curvatures are in opposing directions in an anticlastic membrane.

Form — Course Content

While dealing with the nomenclature we moved to research the form. The known studies indicated that the basics were very simple. We separated the translation surfaces from the domical and the catenoidal forms. That opened the door to the fundamental principles of the synclastic and anticlastic membranes. The two principal curves which are more or less 90 degrees to one another were both curving in the same direction in the synclast, and in the opposite direction in the anticlast. These two shells were relatively easy to make in sheet metal: see Photos 7,5, and Figures 11-13.

FIGURE 13 -
FURROW OR VALLECULATE



twist in a furrowed bending torque

A great many variations pointed to a vast form potential. In addition to the synclast and the anticlast, we also found it necessary to include the twist and the furrow. These four basic forms yielded the operational lingo as well. Quite logically we now used the verbs: anticlastic sinking, synclastic sinking, furrowing and twisting. Many more verbs are needed, but we are confident that they will develop as the technique becomes more generally used. Compression and stretching are also important operational terms in the shell structuring technique.

PHOTO 7 - ANTICLASTIC SINKING

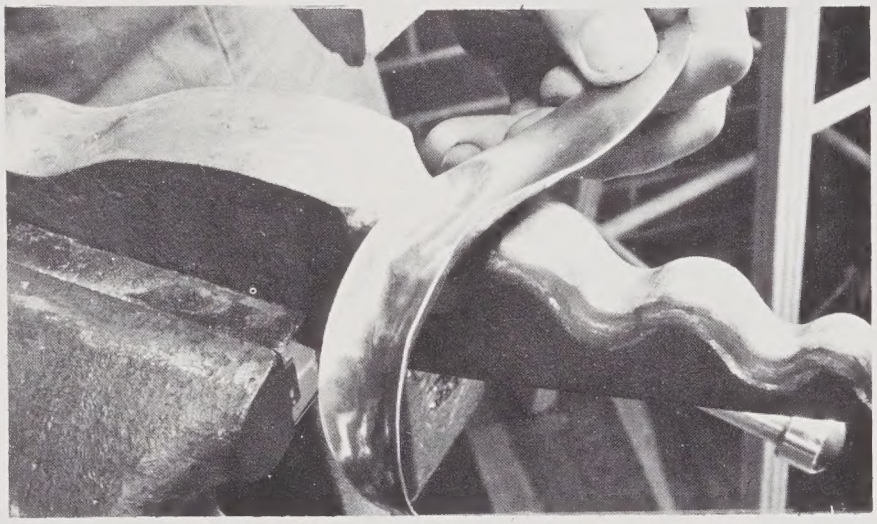


PHOTO 5 - SYNCLASTIC SINKING

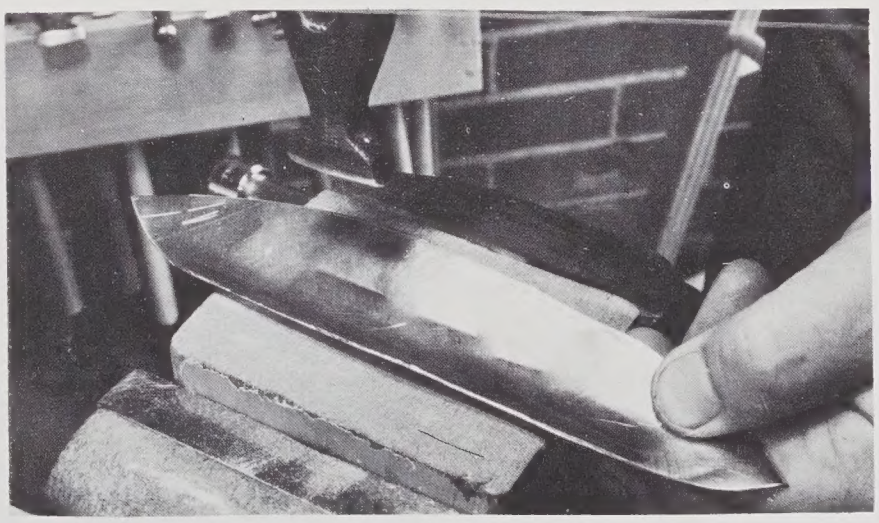


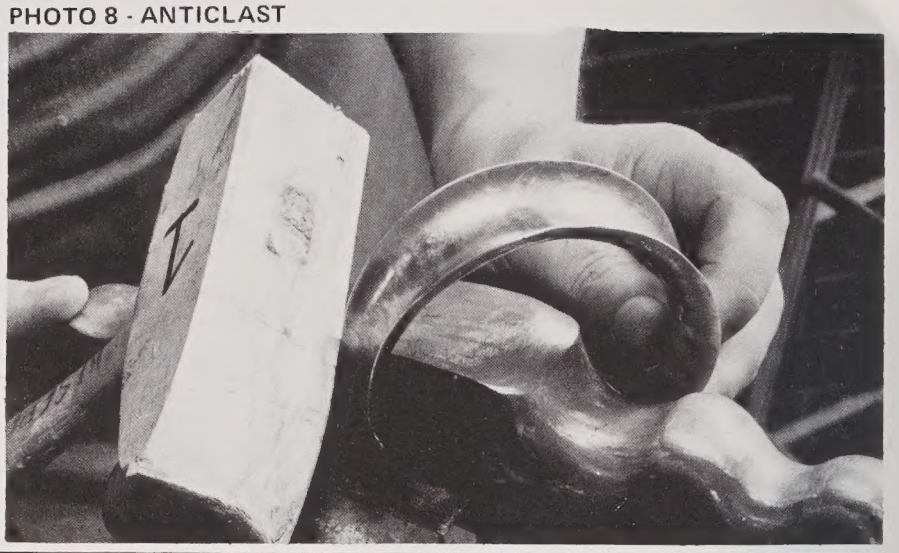
PHOTO 1 - FURROWING

Once the work is begun on the flat sheet, the metalstatis is a combination of both compression and stretching of the sheet.

In the form study we made great use of plastic film. A boundary was made of binding wire. This loose frame was dipped in a liquid plastic which made a membrane within the boundary. A great variety of shells could thus be examined for possible duplication in metal. The forms grew from their *primal state* into their *metamorphic state* by working them with hammers and mallets in the four basic methods mentioned above. Once the satisfactory *metamorphic state* was reached, the same form was used to develop a new *primal state* pattern from which the second shell was to be made, and later mated with the first shell. When mating and joining was complete the total unit became a structure in its *paramorphic state.* As the structure was complete at this time, it could be dissected, quartered, or otherwise cut into to create new forms.

It was necessary to organize divisions in the shell forms even further. There were complete structures that could be made from a single sheet of metal. These were called *monoshells.* The spiculum is a good example. The *bi-shells* were, naturally, made of two shells, as has been described above. The third addition was comprised of everything else — sometimes referred to as *multi-shells.*

PHOTO 8 - ANTICLAST



Tools

The discovery of the shell forms and the miltitude of mutations suddenly within the reach of the silversmith brought about a second look at the tools and the equipment. Thus far, the profession had been at the mercy of left-over stakes and hammers of by-gone times. Through the years, the contemporary metalsmith has changed his tools very little, if at all. Many of his tools came from the manufacturer in unsuitable condition and he was forced to reform them.

In addition there were many gaps and voids in the series of stakes and hammers. A certain rationale was needed in the whole arsenal of tools.

In order to circumvent this deplorable condition we found use in resilient materials such as end-grain wood and plastic for the development of shell structures. The plastics, particularly nylon, proved to be very versatile stake material. It is resilient enough not to mar the sheet while forming, and hard enough to permit planishing to an acceptable degree. Plastic is a good candidate for developing new stakes and mallets in the future.

Conclusions

At this time it would be presumptious to draw any conclusions about the success of this research—it is far too early for that. However, the present indications are that it will change the form consciousness of the metalsmiths for some time to come.

Credits

Since 1973 the following students have been involved with the work on the shell structures, all contributing in their own way:

Graduates: Paulette Myers, Sally Wehrman, John Baltrushunas, Michael Lieber, Susan Kriegman, Judy McGreary-Felch.

Undergraduates: Anne Taussig, David Jaworski, Gordon Small, Gifford Noland, Susan Kesler, Jill Paskow, Matt Mies, Blythe Kupferberg, George Palmer, Margo Griffith-Bean, Martha Gallagher.

Plus a host of others in a lesser way.

The author has given 19 workshop-demonstrations in the United States and abroad on the subject.

Respectfully submitted to the Society of North American Goldsmiths, March 1977.

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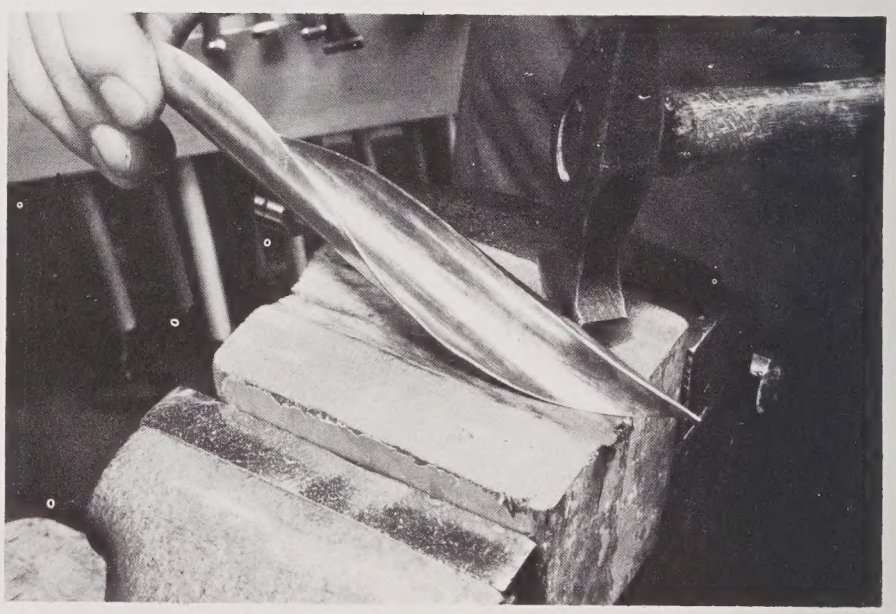

PHOTO 4 - TWIST

PHOTO 10 - THE TOTAL COMPLEMENT OF TOOLS FOR MAKING THE FORMS